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FINAL REPORT  
DESIGN, FABRICATION AND TESTING  
OF  
BLOCK IV DESIGN SOLAR CELL MODULES  
PART II: RESIDENTIAL MODULE

APRIL 1982

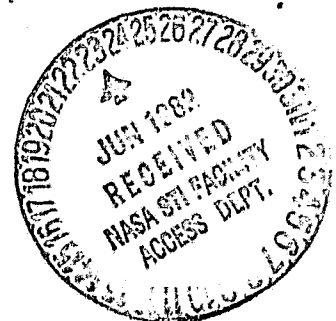
(NASA-CR-169158) DESIGN, FABRICATION AND  
TEST OF BLOCK 4 DESIGN SOLAR CELL MODULES.  
PART 2: RESIDENTIAL MODULE Final Report  
(ARCO Solar, Inc., Chatsworth, Calif.) 36 p  
HC A03/MF A01

N82-26795

Unclas  
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CSCI 10A G3/44

ARCO SOLAR, INC.  
CHATSWORTH, CALIFORNIA 91311  
PREPARED UNDER CONTRACT NO. 955402  
FOR  
JET PROPULSION LABORATORY  
CALIFORNIA INSTITUTE OF TECHNOLOGY  
PASADENA, CALIFORNIA 91103

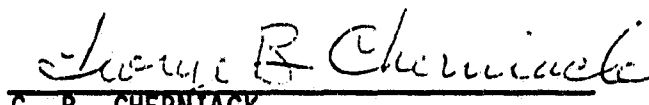


FINAL REPORT  
DESIGN, FABRICATION AND TEST  
OF  
BLOCK IV DESIGN SOLAR CELL MODULES  
PART II: RESIDENTIAL MODULE  
APRIL 1982

WRITTEN BY

  
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PREPARED UNDER CONTRACT NO. 955403  
FOR  
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CALIFORNIA INSTITUTE OF TECHNOLOGY  
PASADENA, CALIFORNIA 91103

The JPL Flat-Plate Solar Array Project is sponsored by the U.S. Department of Energy and forms part of the Solar Photovoltaic Conversion Program to initiate a major effort toward the development of low-cost solar arrays. This work was performed for the Jet Propulsion Laboratory, California Institute of Technology by agreement between NASA and DOE, under NASA Contract.

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ARCO Solar, Inc. believes there are no Subject Inventions made under this contract.

## ABSTRACT

This final design report concludes work performed on the design, fabrication and test of the Block IV Residential Load Module by ARCO Solar, Inc. This report outlines design changes from the proposed module design through three iterations to the discontinuance of testing agreed upon by both JPL and ARCO Solar, Inc.

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## INTRODUCTION

Part II of this report contains the program plan, design data and engineering and manufacturing documentation produced during the development and testing of a Residential Load module by ARCO Solar, Inc. The module described in this report includes two major innovations developed by ARCO for use on the John Long Home Project and proposed for use in the Block IV Residential Program. These are the use of ethylene/vinyl acetate (EVA) encapsulant and a Tedlar® film plastic front cover in a batten and seam roofing design. The design responds to requirements outlined by the Jet Propulsion Laboratory Document No. 5101-83, "Block IV Solar Cell Module Design and Test Specifications for Residential Applications," November 1, 1978.

## PROGRAM OUTLINE

The program followed by ARCO Solar, Inc. during the design and fabrication of the Residential Module deviated from that proposed as we gained experience with the new plastic front, steel substrate module design. The major steps in the program included the following tasks:

1. Module design, including layouts, details and assembly drawings.
2. Design reviews with JPL to approve the Engineering, Manufacturing and Quality Control Documents.
3. Submittal of seven modules for qualification testing.
4. Submittal of the Final Design Report.

## DESCRIPTION OF DESIGN

The concept for the /S, Inc. Residential Module Design was based on a low-cost, batten and seam approach. This design was aimed at providing a module for use on rooftops of homes, apartment complexes and business offices. By eliminating the costly and heavy glass front typifying most photovoltaic module designs, the steel substrate could be a larger, 2-x4-foot size, well suited for the roofing installation business as it allows for the seams to be on 2 foot centers. Several iterations in the design occurred as we gained knowledge through the fabrication of modules for the John Long Project and the building of test samples for submittal to JPL.

Features common to all of the design iterations include the solar cell and circuitry design. Cells are 4.05 inches in diameter, single crystal grown by Czochralski technique. The ingots are sliced into wafers, texture etched and diffused for a shallow junction. Discrete pad ohmic contacts are printed using a thick film paste of silver on the front and a combination of silver and aluminum on the back surface. This printing technique is amenable to high volume and is presently used in our manufacturing plant.

Contact to the cell comes from the soldering of coated copper buss ribbon across the faces of the cell. Dual redundant ribbons on both front and back, soldered in many places, reduce the risk of power loss due to cell breakage. The contacts made to the discrete ohmic pads also allow for strain relief during thermal excursions.

The circuitry of three parallel strings allows for more fault protection than a single string module, and reducing the number of cells in series to 20 reduces the amount of hot spot heating possible. The provision of a bypass diode external to the circuit also reduces the hot spot problem.



Other features common to all iterations include the use of a plastic coated steel substrate with thin plastic film cover. This allows for lighter weight and less cost per area compared to glass front designs. Ethylene/vinyl acetate (EVA) pottant was used on all iterations for its superior hot spot endurance and lower moisture permeability.

Dual redundant terminations are a common feature in all of the rooftop designs as it provides for easy interconnection of modules under the battens. Grounding of modules also takes place here with the use of sheet metal screws through tabs on the substrate pan. Overlapping of modules combined with batten-covered edges gives water-repellant electrical connections and high packing density on the roof.

As outlined in the original proposal, the first design iteration included a Korad® acrylic film-coated steel substrate, EVA encapsulant and clear Korad® film cover. This design was used on the John Long Project and included a bent copper clip termination. Buss bars protruded from the laminate and bent over the flanges of the module pan. The clips were forced over these buss bars to make contact.

Several problems were encountered with this design, the major being electrical isolation of conductive components. The Korad® coating on the substrate pan was easily scratched, providing a shorting path to ground. Dielectric standoff was adequate as long as no scratches occurred. The spring clip and buss bar folded around the pan also posed an electrical standoff problem. Nomex® dielectric paper and polyester tape used in the terminal area provided the necessary isolation here. A secondary problem with this design was the moisture pick-up by the Korad® film. Evidence of this problem was seen during internal ARCO Solar qualification testing.

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Because of the problems associated with Korad®, a new film was used in the second design. The second design incorporated Tedlar®-coated steel substrate pans and a clear film of 0.002-inch-thick Tedlar® as a cover sheet. Terminations included dual positive and negative pigtails. The substrate pan was used as a strain relief in this design. The diode was also changed to accept a higher current level. Seven modules of this version were submitted to JPL for testing. Internal qualification testing at AS, Inc. during the time of submittal showed some problems with this design also. The 2-mil Tedlar® cover film shrank excessively at high temperatures causing the film to peel away from the edges and resulting in delamination. The modules were recalled from JPL for a new submittal.

The third version of the design substituted 4-mil Tedlar® as a cover film to help the shrinkage problem. Seven new modules were submitted for test. Nine modules of this design were also submitted to AS, Inc. internal testing. After exposure to the Block IV specified thermal cycling, delamination occurred in the terminal area on these nine. This is consistent with the findings of JPL testing. The delamination was caused by stressing of the Tedlar® when terminations were prepared and the Tedlar® appeared to pull back a certain amount then stop. The delamination did not appear to progress further with more exposure. The failure of these modules to meet the visual criteria outlined in the Block IV specification prohibited continuing of tests. An agreement by ARCO Solar, Inc. and JPL was reached to end the program.

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## DESIGN DATA

The key elements of the final design described above are outlined in Table 1. The cells, circuit and module are included.

The power output of the module at 28°C and 1000 W/m<sup>2</sup> is a nominal 62 watts. A typical I-V curve is shown in Figure 1 at these conditions.

Direct roof mounting of this module results in a high Nominal Operating Cell Temperature of 65°C (at 20°C ambient, 1000 W/m<sup>2</sup>, 1 m/s wind). The module derating coefficients are 3.66 mA/°C/module and 49 mV/°C/module. Data at 28°C, 1000 W/m<sup>2</sup> and at NOCT, 1000 W/m<sup>2</sup> are given in Table II for both cell and module. The respective efficiencies are also included.

## ENGINEERING AND MANUFACTURING DOCUMENTATION

Layouts, details and assembly drawings done for the Residential Block IV Module Design are attached as an appendix. The module drawings include the latest revision only. These drawings detail the module submitted for final testing.

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## TABLE I

### KEY ELEMENTS OF RESIDENTIAL MODULE DESIGN

#### CELLS

- 4.05 inch (103 mm) Czochralski single crystal silicon wafers, 12 mils thick
- Texture etched surface
- Discrete pad ohmic contacts, two sets
- Thick film printed silver front collection grid and contacts
- Thick film printed aluminum back collector
- Shallow diffusion

#### CIRCUIT

- Redundant buss bar interconnects
- Discrete pad ohmic contact system for stress relief
- 60 cells connected in three series strings of 20 each protected by external diode

#### MODULE

- 2-x4-foot nominal size
- Tedlar® coated steel substrate
- Clear Tedlar® cover film
- Two sets of pigtails, one each on either side of module

FIGURE 1

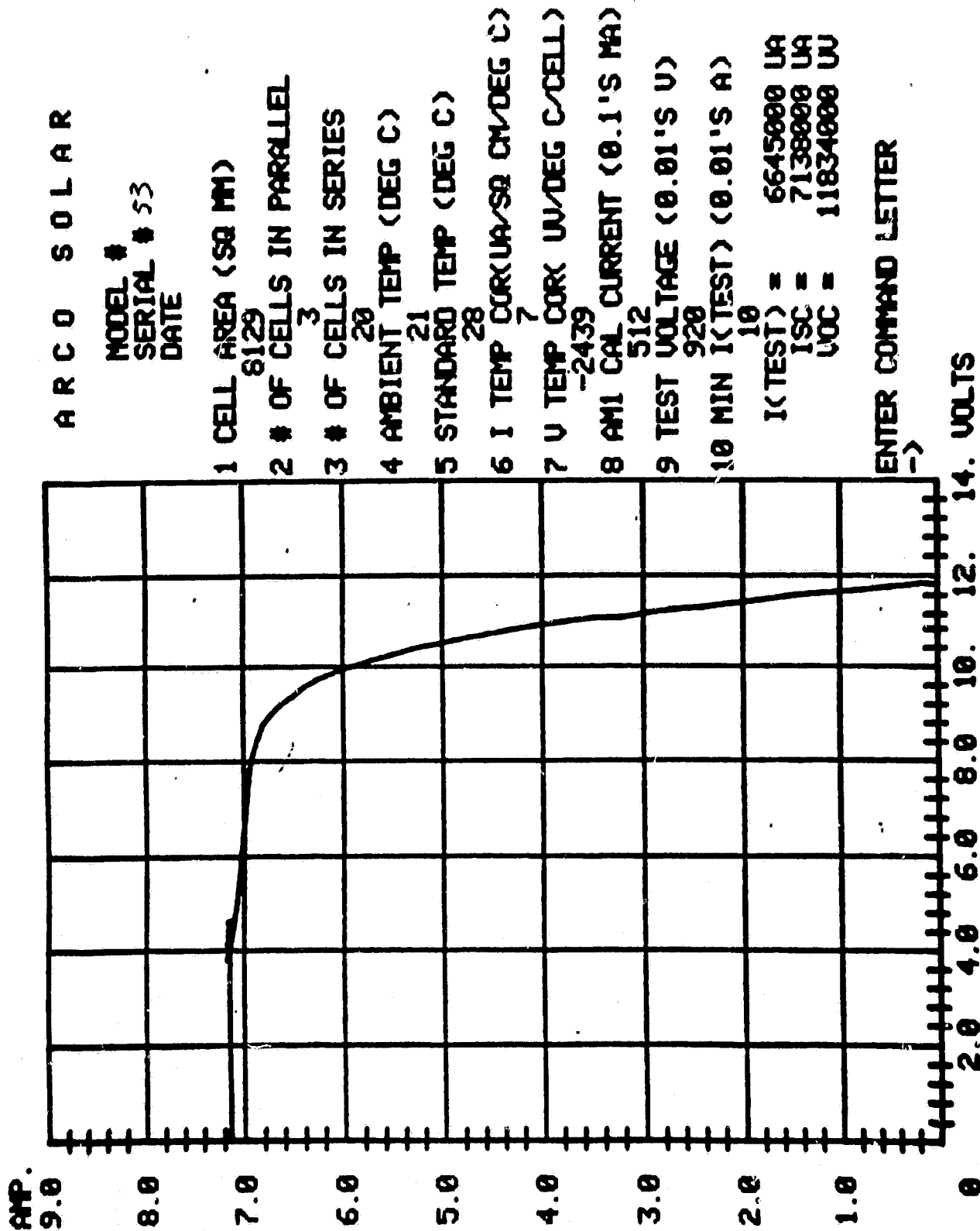


TABLE II

CELL/MODULE CHARACTERISTICS

RESIDENTIAL BLOCK IV DESIGN

AM 1.5      1000 W/m<sup>2</sup>

	<u>CELL</u>		<u>MODULE</u>	
	<u>28°C</u>	<u>65°C</u>	<u>28°C</u>	<u>65°C</u>
V <sub>oc</sub> , Volts	0.595	0.505	11.9	10.1
I <sub>sc</sub> , Amps	2.30	2.32	7.04	7.10
V <sub>L</sub> , Volts	0.480	0.390	9.60	7.80
I <sub>L</sub> , Amps	2.15	2.17	6.58	6.64
P <sub>L</sub> , Watts	1.03	0.85	63.2	51.8
$\eta_{aa}^*$	12.6%	10.4%	13.0%	10.6%
$\eta_{mod}^*$			9.8%	8.0%

Cell area: 81.3 cm<sup>2</sup>

Module area: 6437.0 cm<sup>2</sup>

Three parallel strings of 20 cells each

\* $\eta_{aa}$  = efficiency based on cell area       $\eta_{mod}$  = efficiency based on module area

## APPENDIX

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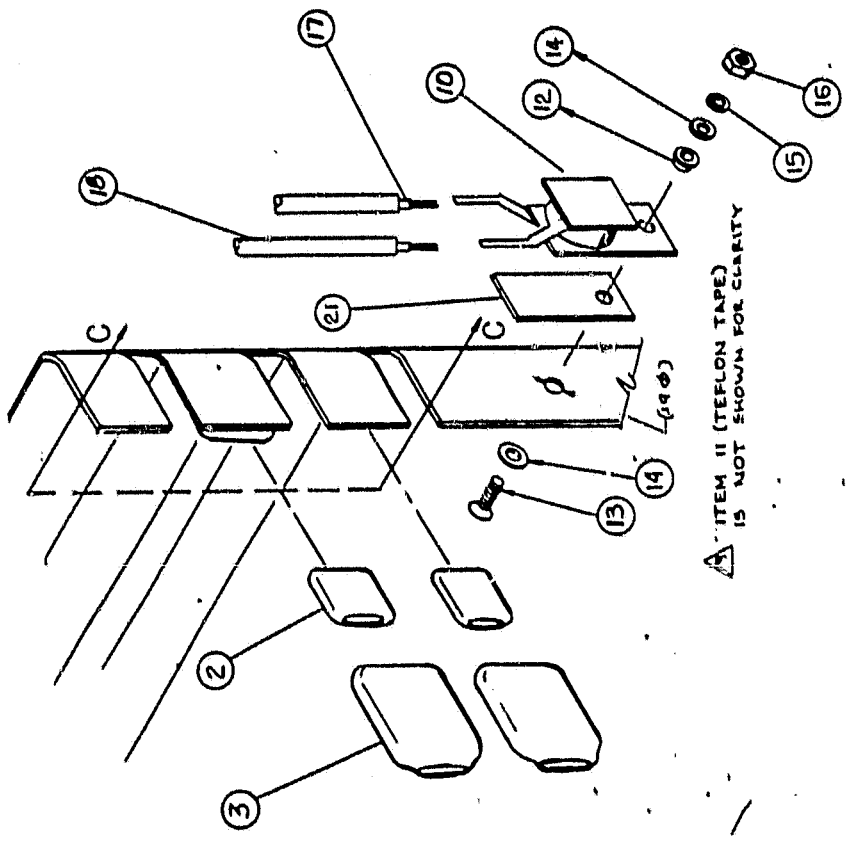
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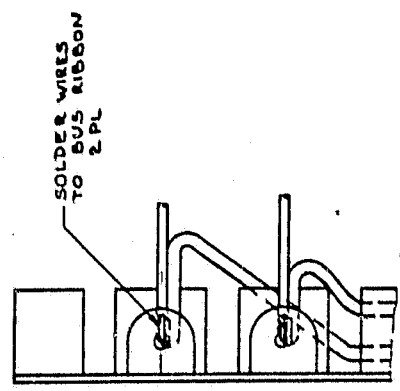
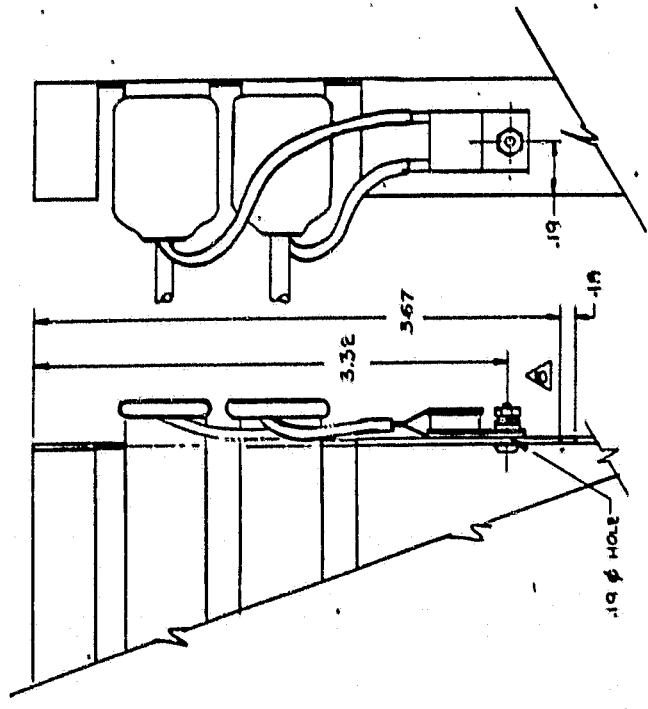
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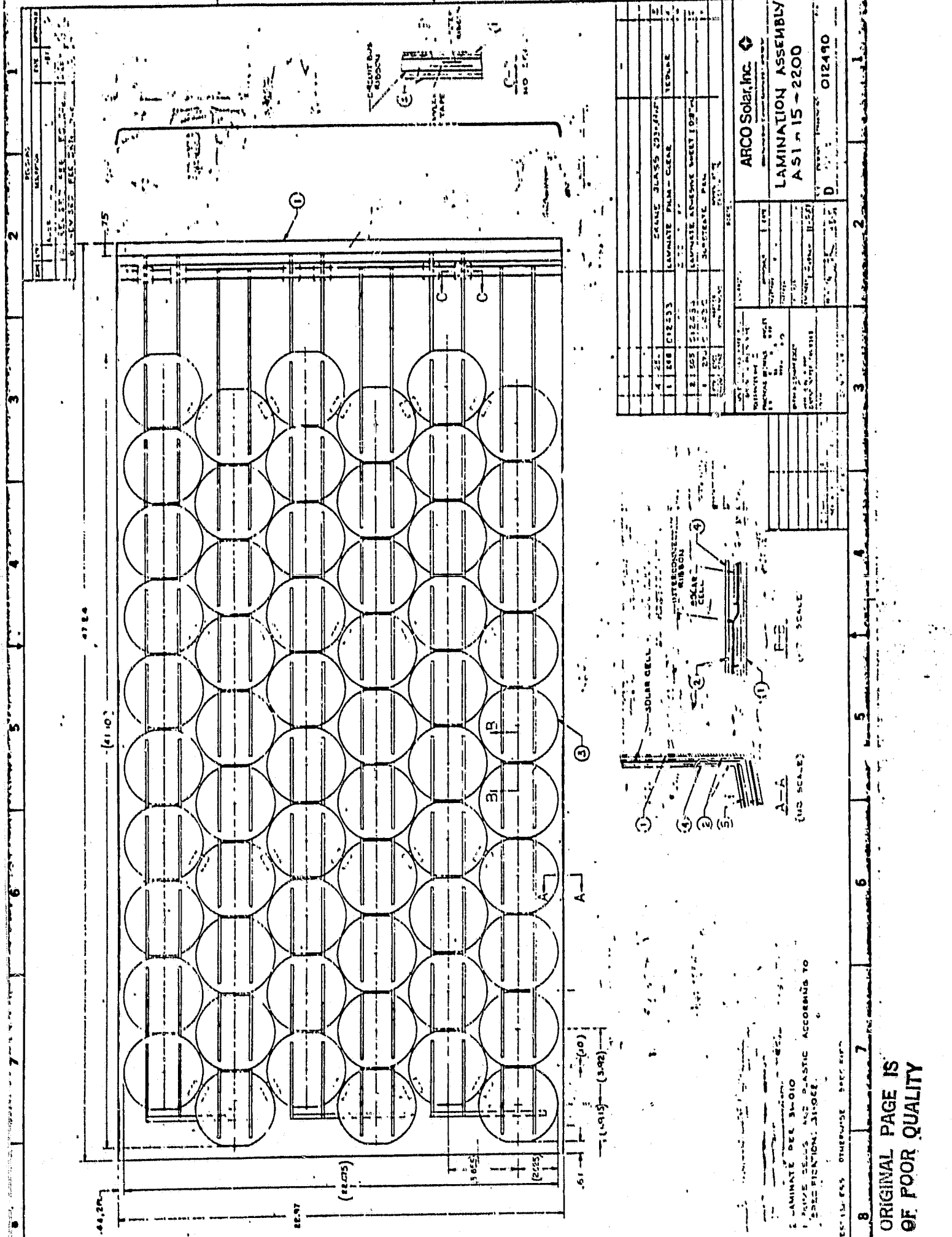


VIEW C-C

(ITEMS 2 & 3 ARE NOT SHOWN)

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1/64 .000781 7 1/2'					
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ARCO Solar, Inc.					
ASI 15-2200					
RESIDENTIAL MODULE ASSEMBLY					
DATE 7/26/81					
APPROVALS: MICK					
DESIGNED BY: TESSER					
CHECKED BY: TESSER					
APPROVED BY: TESSER					
SCALE: 1" = 1" (SEE NOTE)					
SHEET 2 OF 2					

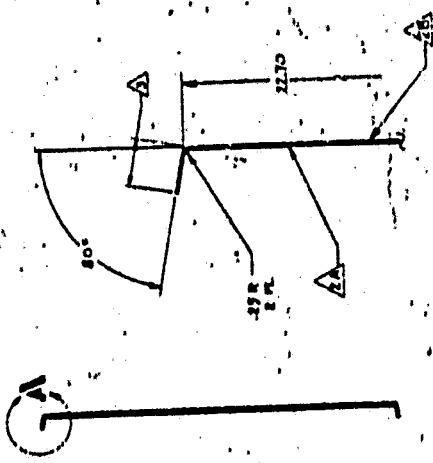


ARCO Solar, Inc.	
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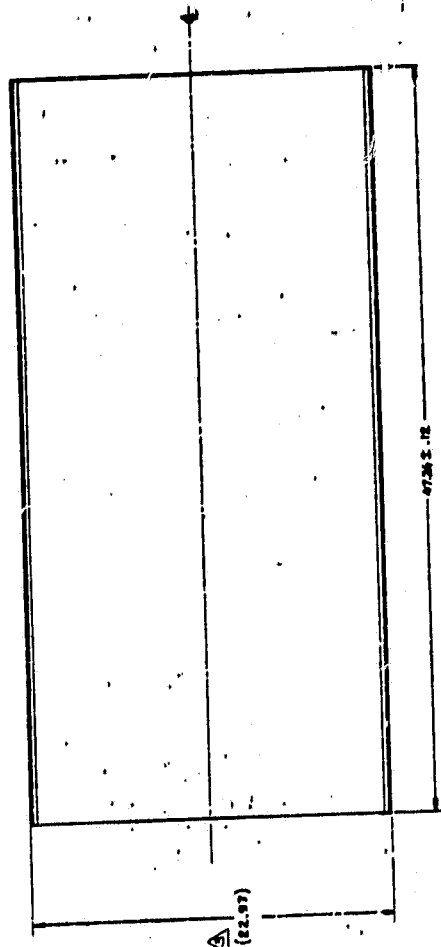
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DETAIL A  
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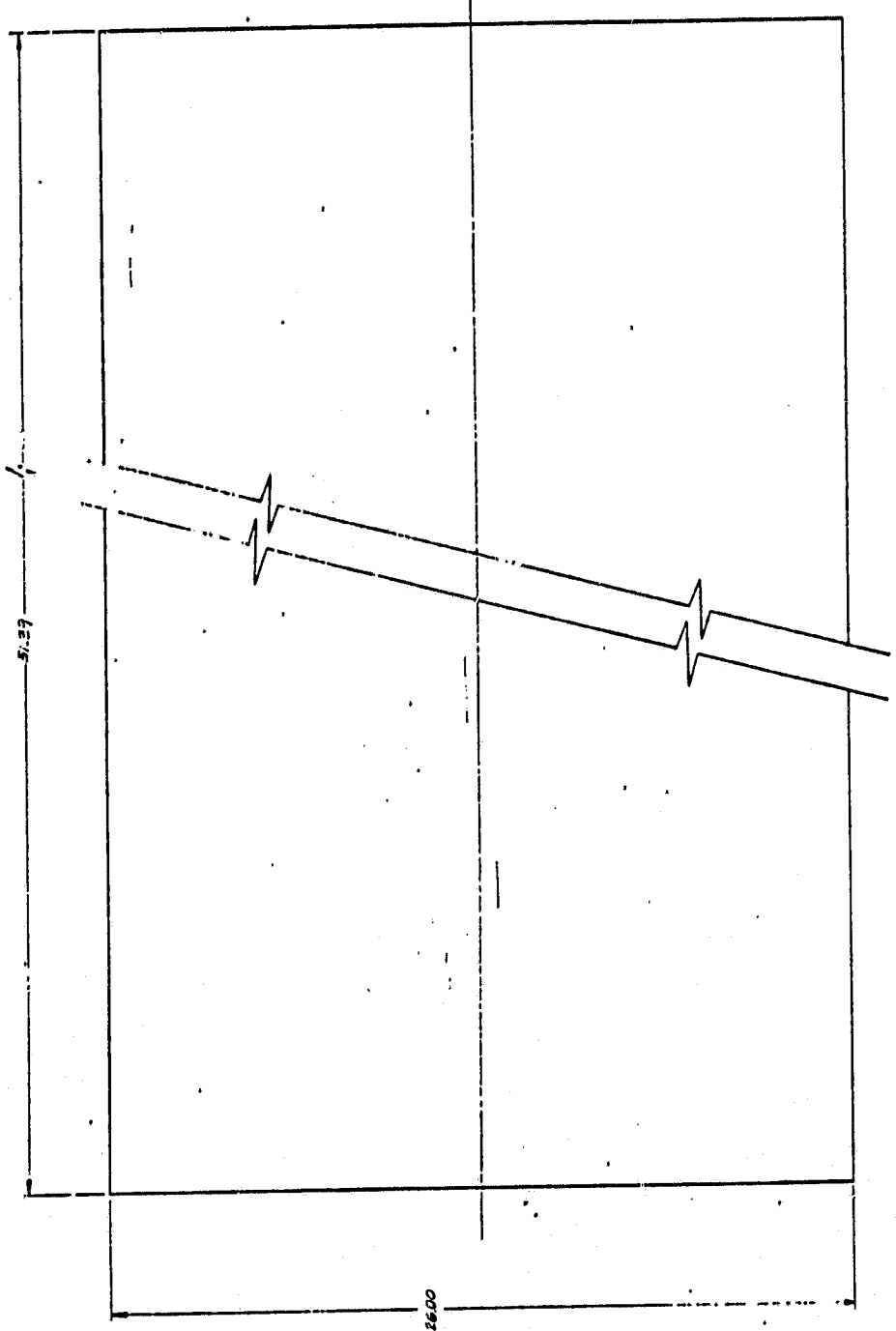
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2	11/18/81	W.E. MCNEIL	W.E. MCNEIL	W.E. MCNEIL

ARCO Solar, Inc.

- A THE ATYP. VALUE OF THE SIDE FLANGES TO BE USED IN THE PAN IS 1/2 TO 2/3. BOTH FLANGES TO BE USED WITHIN 2.03.
- B FINISH: A. BOND INSIDE OF PAN WITH .0015 THICK TIECLIP P/L 2477C1249-00. B. BACK SIDE TO HAVE A CLEAR EPOXY WASH .0004 THK. MAX.
- C MATERIAL: 1. 1/2" THK. GALVANIZED STEEL SHEET PER ASTM-A-666, GRADE 50.

UNLESS OTHERWISE SPECIFIED

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5	12/15/83	REVISED PER COMMENTS	WJ	WJ
6	12/15/83	REVISED PER COMMENTS	WJ	WJ
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RESIDENTIAL MODULE		0244		12/15/83	

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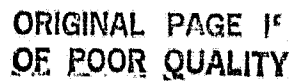


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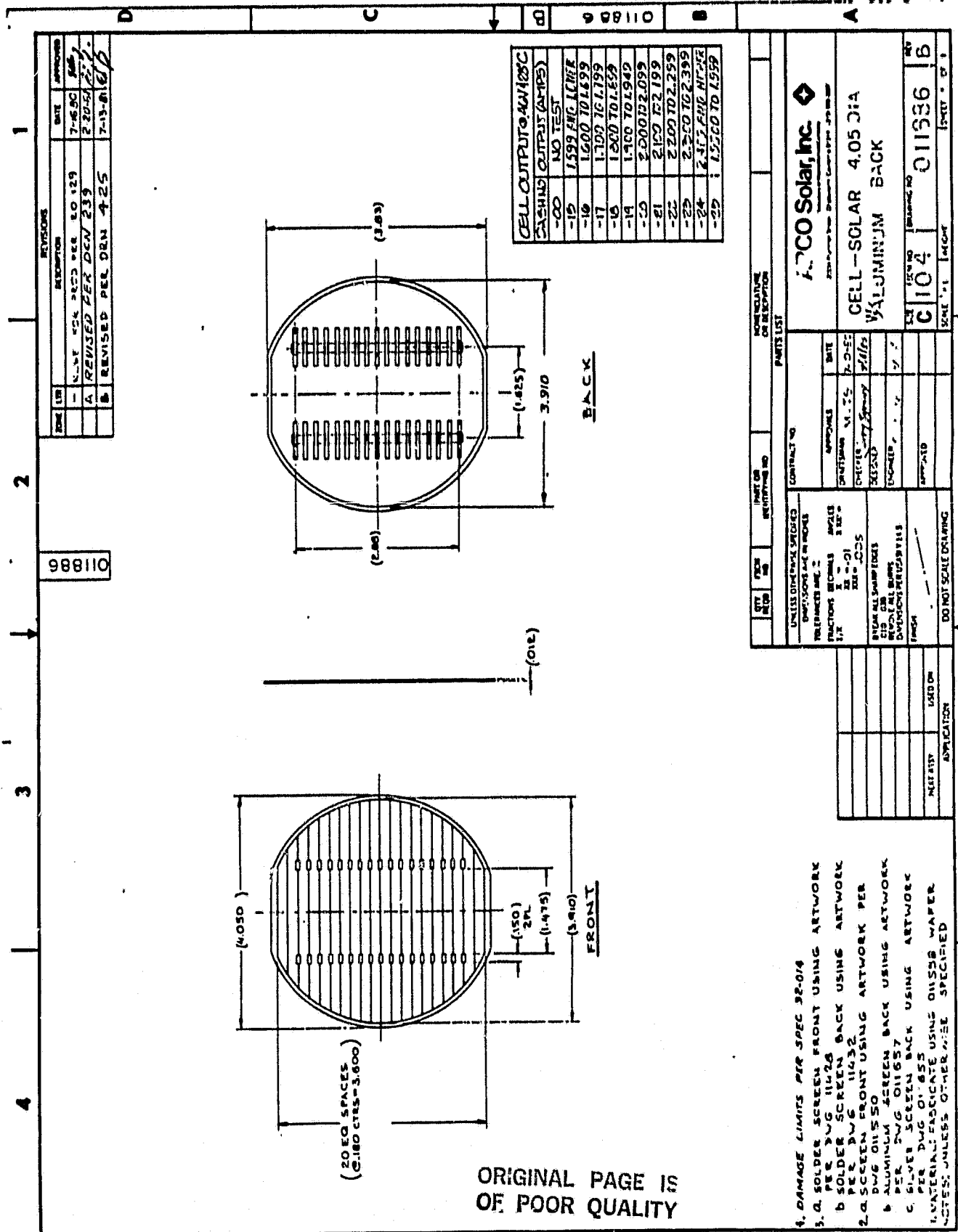
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2. APPLY CLEAR TEPLAR (ITEM 2)  
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BUS RIBBON AS SHOWN  
1. COPPER RIBBON WITH SOLDER FINISH  
NOTES: PER SPEC 20-001.





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988110

1. DAMAGE LIMITS PER SPEC 32-014
2. SOLDER SCREEN FRONT USING ARTWORK PER DWG 11424
3. SOLDER SCREEN BACK USING ARTWORK PER DWG 11432
4. SCREEN FRONT USING ARTWORK PER DWG 011550
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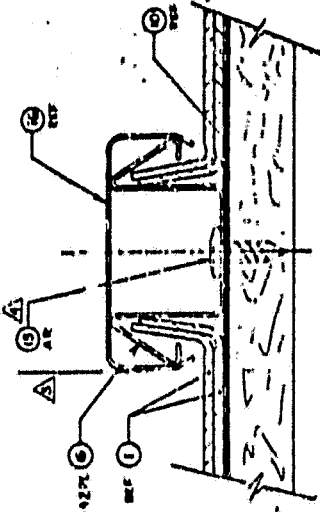
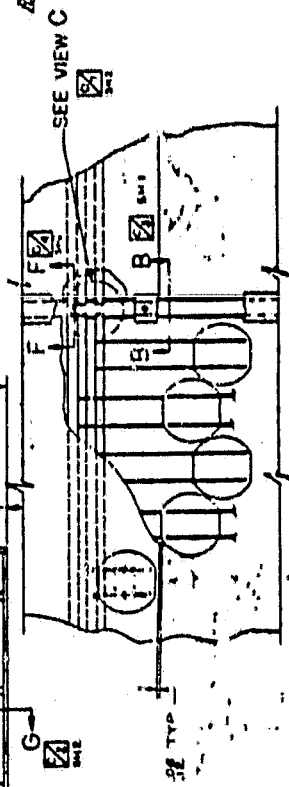
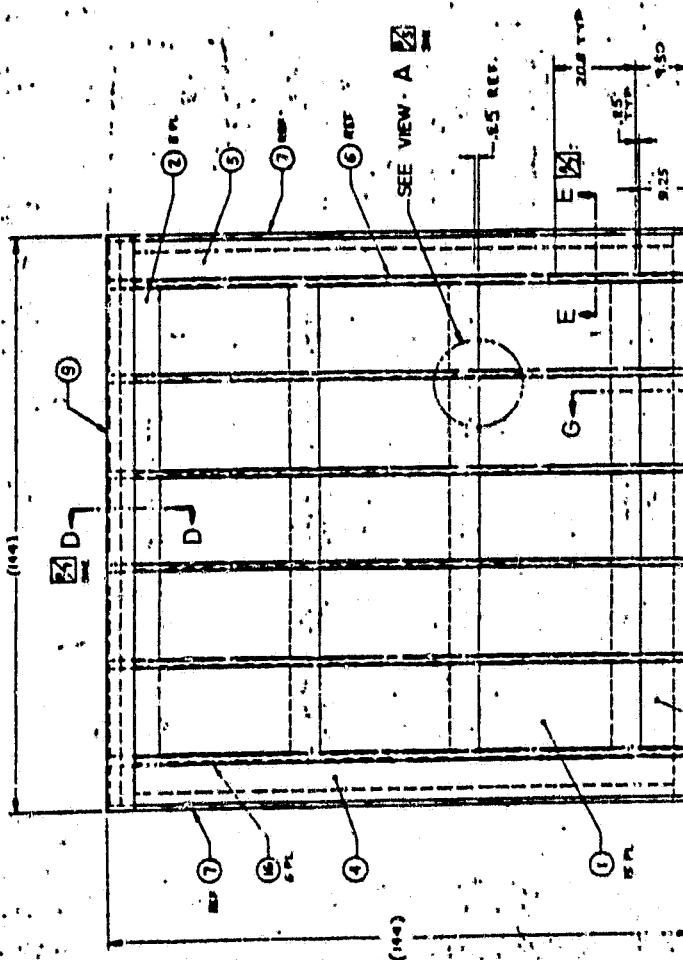
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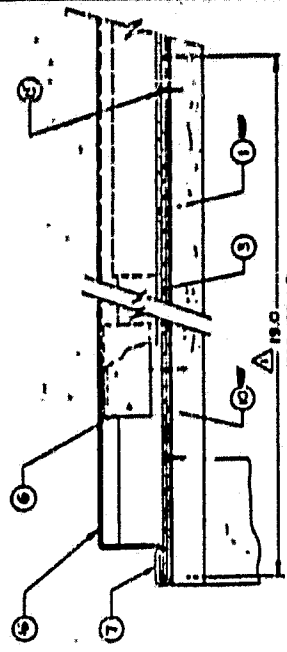
[illegible]

1. AVERAGE - TBD  
 2. NOMINAL OPERATING VOLTAGE 20  
 3. SCREWS INSTALLED WITH IMPACT DRIVER -  
 4. SHADOW COEFFICIENT 0.02  
 5. CAN PL. STEEL, SUGGESTED SOURCE: DIAMOND TOOL SUPPLY  
 6. WELDOUT FLANGES TO FIT STARTER (HUM ?) OR CLOSURE (HEMS)  
 NOTE: UNLESS OTHERWISE SPECIFIED

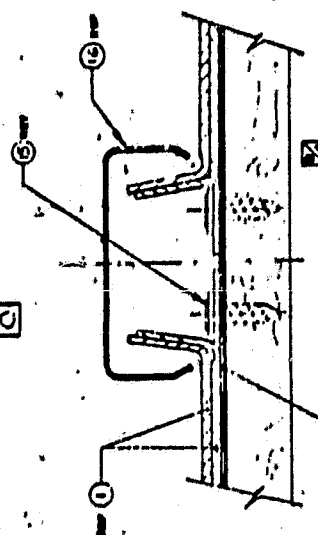
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REV	DATE	BY	CHKD	APP'D
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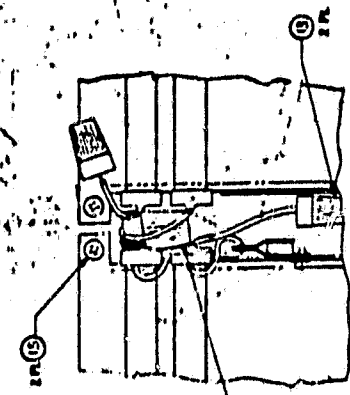
012441



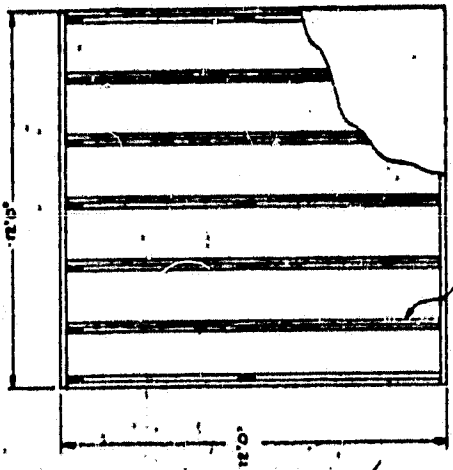
SECTION G-G  
SCALE: 1/2" = 1'



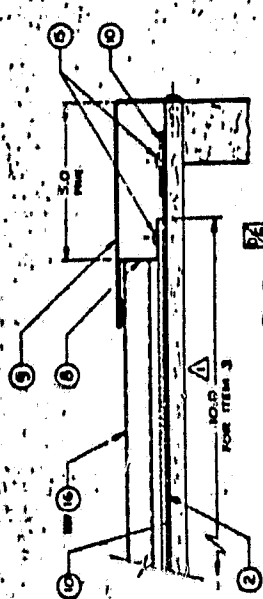
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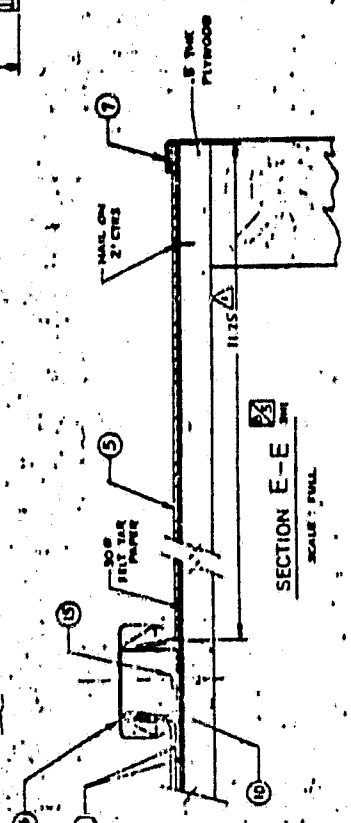
VIEW C  
SCALE: 1/2" = 1'



TYPICAL SUBSTRATE SUPPORT FRAME  
SCALE: 1/2" = 1'



SECTION D-D  
SCALE: 1/8" = 1'  
ROTATED 90°



SECTION E-E  
SCALE: 1/2" = 1'

REV		DATE	BY	CHKD	APP'D
1	10/1/81	WAL	WAL	WAL	WAL

REV		DATE	BY	CHKD	APP'D
1	10/1/81	WAL	WAL	WAL	WAL

REV		DATE	BY	CHKD	APP'D
1	10/1/81	WAL	WAL	WAL	WAL

REV		DATE	BY	CHKD	APP'D
1	10/1/81	WAL	WAL	WAL	WAL

REV		DATE	BY	CHKD	APP'D
1	10/1/81	WAL	WAL	WAL	WAL

REV		DATE	BY	CHKD	APP'D
1	10/1/81	WAL	WAL	WAL	WAL

REV		DATE	BY	CHKD	APP'D
1	10/1/81	WAL	WAL	WAL	WAL

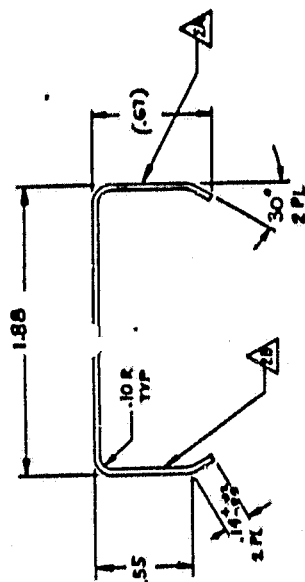
REV		DATE	BY	CHKD	APP'D
1	10/1/81	WAL	WAL	WAL	WAL

ARCO Solar, Inc.  
INTERFACE CONTROL DRAWING  
ASI RESIDENTIAL MODULE  
INSTALLATION

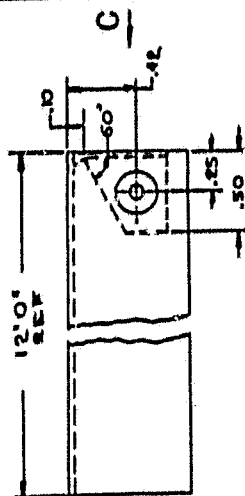
012441

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OF POOR QUALITY

NOTES: UNLESS OTHERWISE SPECIFIED



-02  
(OPEN END)





view C

-01  
(CLOSED END)

PCP SWEET  
CREES, 105 x 50  
PL

REVIEWS				
LINE	DESCRIPTION	DATE	APPROVED	
B	ISSUED WITH CHARGES PER EO 1173	1-15-72	155	1/16/72
C	REVISED PER EO 117	1-25-72	155	1/25/72
D	REVISED PER EO 215	1-30-72	155	1/30/72

QTY REQD	UNIT REQD	UNIT OF MEASURE	QUANTITY	CONTRACT NO	PARTS LIST		ARCO Solar, Inc.  88000 Highway 200 • Thousand Oaks, CA 91320		SCALE 1" = 1' 0" SHEET 1 OF 1
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE ±				APPROVALS CONTRACTOR P. S. S. 9-18-86 CHECKED BY J. S. 9-18-86 DESIGNED BY J. S. 9-18-86 ENGINEER P. S. S. 9-18-86		DATE 9-18-86 TIME 1:22 P.M.		ASI RESIDENTIAL MODULE BATTEN	
WEAR ALL SHARP EDGES 610 AND 615 610 AND 615 DIMENSIONS PER UGAS 145				APPROVED P. S. S. 9-18-86		SIZE 270 FINISHING NO 011691		ARCO D	
FINISH 				DO NOT SCALE DRAWING					

**DOCUMENT**

2

069110

1

REVISIONS

ZONE LTR

DESCRIPTION

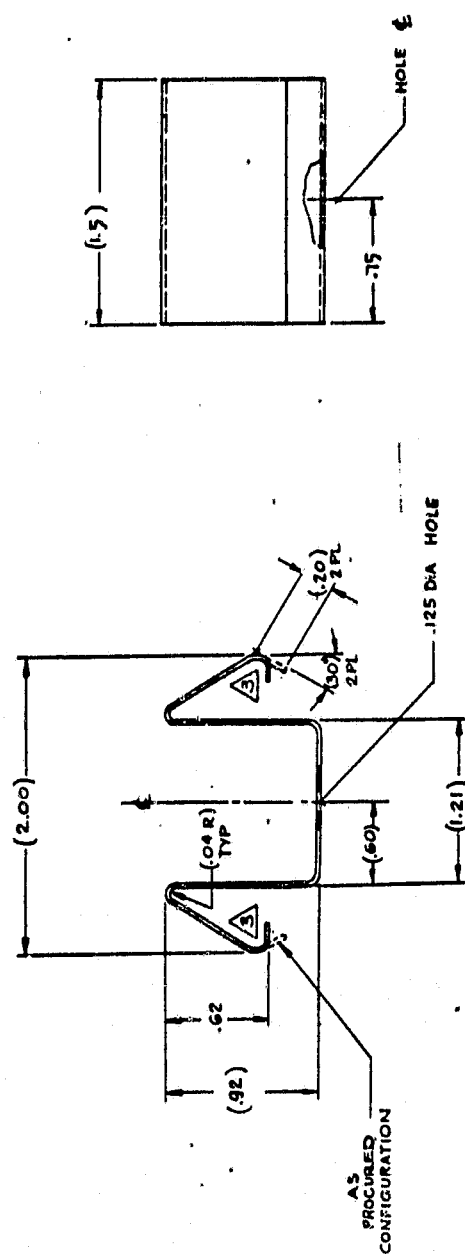
DATE

APPROVED

CHANGE FROM 272

3-4-81

EJP



ALTERED PART

—OI SHOWN

ORIGINAL PAGE IS  
OF POOR QUALITY

**FORM TO SHAPE SHOWN.**

2. SOURCE: ARCHITECTURAL ENG. PRODUCTS  
SAN DIEGO, CA.  
PART NO. BC-1

1. MATL: 24 GAGE ZINC GALVANIZED STEEL  
SHEET, PER ASTM-A-446, GRADE A, G-90

**NOTES:**

**APPLICATION**

**DO NOT SCALE DRAWING**

**FINISH**

**REMOVE ALL BURRS**

**BREAK ALL SHARP EDGES**

**OLD**

**012491**

**011760**

**J LONG I**

**PL**

**USED ON**

**NAT ASSY**

**APPLICATION**

**DO NOT SCALE DRAWING**

**FINISH**

**REMOVE ALL BURRS**

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**REMOVE ALL BURRS**

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**USED ON**

**NAT ASSY**

**APPLICATION**

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U

for latest rev.  
docum. in C.I.L.S.

012437

20

A

A FINISH: A BOND TOP OF PAN WITH .0015THK  
TEDLAR FILM, COLOR CHARCOAL  
NO 150E130CC

BACK SIDE TO HAVE A CLEAR EPOXY  
WASH, 2504 THK MAX

1. 29 BAGE, 2000-2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680,

GA 11 23 3716 23m.6 443' 00 31.4

**ARCO Solar, Inc.** 

BLANK PANEL UPPER

012437	012437	012437	012437
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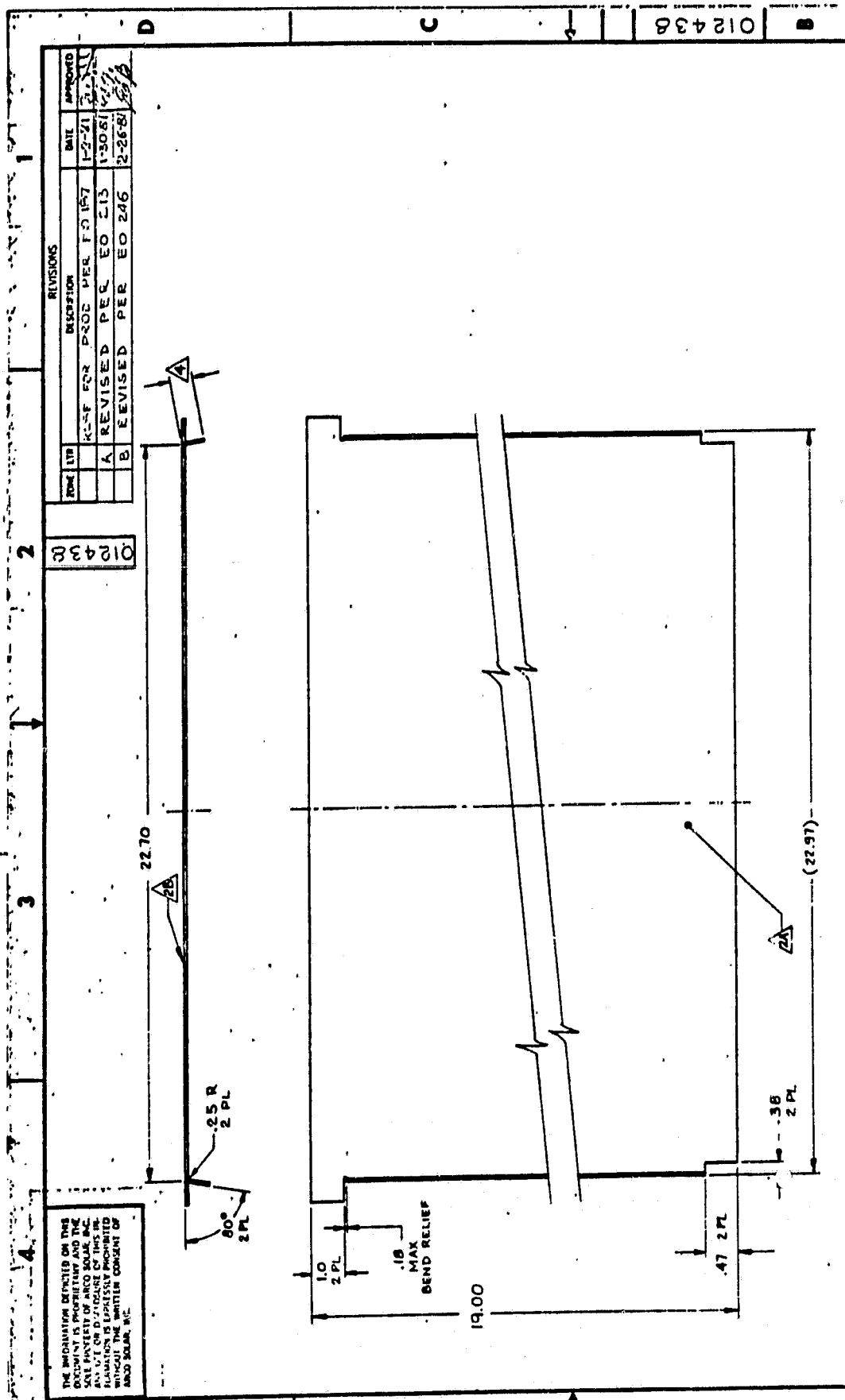
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80				



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REVISIONS				
FORM	LTB	DESCRIPTION	DATE	APPROVED
		REF FOR PROE PER FO 157	1-2-71	W
	A	REVISED PER EO 113	1-30-81	W
	B	REVISED PER EO 246	2-26-81	W

[illegible]

3) THE ACTUAL VALUE OF THE SIDE FLANGES TO BE DETERMINED BY THE WIDTH OF THE RAW STOCK (24.00  $\pm$  .25) AND THE PAN HELD TO 22.10  $\pm$  .03. BOTH FLANGES TO BE EQUAL WITHIN  $\pm$  .03

[2] Finish: A. BOND TOP OF CAN WITH DRYSPAC  
Curing: CHARCOAL NO.150EL30CC.

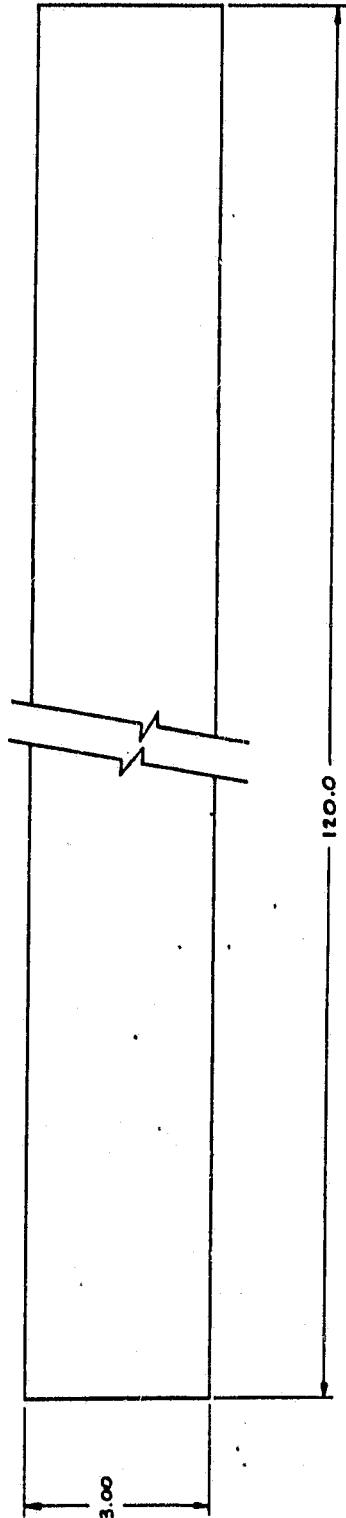
B. BACK SIDE TO HAVE A CLEAR FRONT  
WASH, . . . AND THE BACK.


1. POSTAGE, - IN CALIF. RES. TEL. SURV.  
TEL. A-TN-4-386, SAN V. 4, 6-90

UNLESS OTHERWISE SPECIFIED

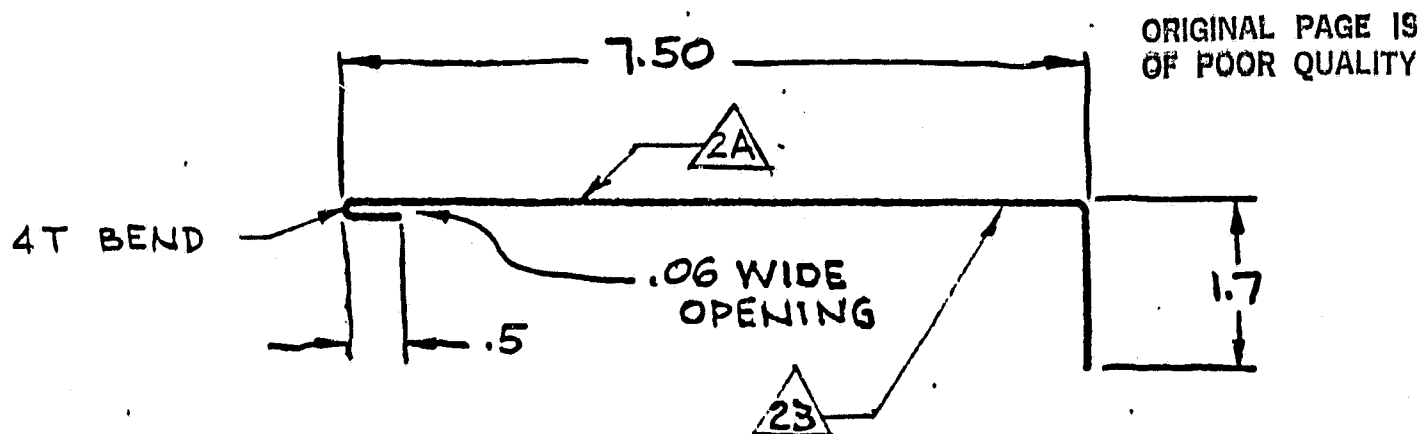
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REVISIONS			
ZONE	LINE	DESCRIPTION	DATE APPROVED
		RELEASE PER DEN 272	3-16-80 <i>ESL</i>



QTY REQD		FROM NO		PART OR IDENTIFYING NO		NOMENCLATURE OR DESCRIPTION	
PARTS LIST							
UNLESS OTHERWISE SPECIFIED - DIMENSIONS ARE IN INCHES TOLERANCES ARE ±				CONTRACT NO.		ARCO Solar, Inc. 	
FRACTIONS DECIMALS ANGLES 1/8 .125 30° 30'				APPROVALS		WIRE RACEWAY PLATE, 1/2"	
1/4 .250 45° 45'				DRAFTSMAN K. J. S.		RESIDENTIAL MODULE	
3/8 .375 60° 00'				CHECKED J. S.		DATE 5-6-80	
1/2 .500 90° 00'				DISCORDER K. J.		DATE 5-6-80	
3/4 .750 120° 00'				ENGINEER J. S.		DATE 5-6-80	
1 .000 150° 00'				APPROVALS		DATE 5-6-80	
1 1/4 1.250 180° 00'				APPROVALS		DATE 5-6-80	
1 1/2 1.500 210° 00'				APPROVALS		DATE 5-6-80	
1 3/4 1.750 240° 00'				APPROVALS		DATE 5-6-80	
2 .000 270° 00'				APPROVALS		DATE 5-6-80	
2 1/4 2.250 300° 00'				APPROVALS		DATE 5-6-80	
2 1/2 2.500 330° 00'				APPROVALS		DATE 5-6-80	
2 3/4 2.750 360° 00'				APPROVALS		DATE 5-6-80	
3 .000 390° 00'				APPROVALS		DATE 5-6-80	
3 1/4 3.250 420° 00'				APPROVALS		DATE 5-6-80	
3 1/2 3.500 450° 00'				APPROVALS		DATE 5-6-80	
3 3/4 3.750 480° 00'				APPROVALS		DATE 5-6-80	
4 .000 510° 00'				APPROVALS		DATE 5-6-80	
4 1/4 4.250 540° 00'				APPROVALS		DATE 5-6-80	
4 1/2 4.500 570° 00'				APPROVALS		DATE 5-6-80	
4 3/4 4.750 600° 00'				APPROVALS		DATE 5-6-80	
5 .000 630° 00'				APPROVALS		DATE 5-6-80	
5 1/4 5.250 660° 00'				APPROVALS		DATE 5-6-80	
5 1/2 5.500 690° 00'				APPROVALS		DATE 5-6-80	
5 3/4 5.750 720° 00'				APPROVALS		DATE 5-6-80	
6 .000 750° 00'				APPROVALS		DATE 5-6-80	
6 1/4 6.250 780° 00'				APPROVALS		DATE 5-6-80	
6 1/2 6.500 810° 00'				APPROVALS		DATE 5-6-80	
6 3/4 6.750 840° 00'				APPROVALS		DATE 5-6-80	
7 .000 870° 00'				APPROVALS		DATE 5-6-80	
7 1/4 7.250 900° 00'				APPROVALS		DATE 5-6-80	
7 1/2 7.500 930° 00'				APPROVALS		DATE 5-6-80	
7 3/4 7.750 960° 00'				APPROVALS		DATE 5-6-80	
8 .000 990° 00'				APPROVALS		DATE 5-6-80	
8 1/4 8.250 1020° 00'				APPROVALS		DATE 5-6-80	
8 1/2 8.500 1050° 00'				APPROVALS		DATE 5-6-80	
8 3/4 8.750 1080° 00'				APPROVALS		DATE 5-6-80	
9 .000 1110° 00'				APPROVALS		DATE 5-6-80	
9 1/4 9.250 1140° 00'				APPROVALS		DATE 5-6-80	
9 1/2 9.500 1170° 00'				APPROVALS		DATE 5-6-80	
9 3/4 9.750 1200° 00'				APPROVALS		DATE 5-6-80	
10 .000 1230° 00'				APPROVALS		DATE 5-6-80	
10 1/4 10.250 1260° 00'				APPROVALS		DATE 5-6-80	
10 1/2 10.500 1290° 00'				APPROVALS		DATE 5-6-80	
10 3/4 10.750 1320° 00'				APPROVALS		DATE 5-6-80	
11 .000 1350° 00'				APPROVALS		DATE 5-6-80	
11 1/4 11.250 1380° 00'				APPROVALS		DATE 5-6-80	
11 1/2 11.500 1410° 00'				APPROVALS		DATE 5-6-80	
11 3/4 11.750 1440° 00'				APPROVALS		DATE 5-6-80	
12 .000 1470° 00'				APPROVALS		DATE 5-6-80	
12 1/4 12.250 1500° 00'				APPROVALS		DATE 5-6-80	
12 1/2 12.500 1530° 00'				APPROVALS		DATE 5-6-80	
12 3/4 12.750 1560° 00'				APPROVALS		DATE 5-6-80	
13 .000 1590° 00'				APPROVALS		DATE 5-6-80	
13 1/4 13.250 1620° 00'				APPROVALS		DATE 5-6-80	
13 1/2 13.500 1650° 00'				APPROVALS		DATE 5-6-80	
13 3/4 13.750 1680° 00'				APPROVALS		DATE 5-6-80	
14 .000 1710° 00'				APPROVALS		DATE 5-6-80	
14 1/4 14.250 1740° 00'				APPROVALS		DATE 5-6-80	
14 1/2 14.500 1770° 00'				APPROVALS		DATE 5-6-80	
14 3/4 14.750 1800° 00'							

APPLICATION		REVISIONS			
NEW ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
			RLSE. FOR PROD PER EO 187	1-8-81	<i>[Signature]</i>
		A	REVISED PER EO 213	1-31-81	<i>[Signature]</i>



**UNCONTROLLED DOCUMENT**

For latest revision, check with document control.

3. LENGTH: 12' 0"

2. FINISH: A. .0015 THICK TEDLAR FILM, COLOR LEAD CHARCOAL #15QBL30CC ON SIDE SHOWN

B. OPPOSITE SIDE TO HAVE A CLEAR EPOXY WASH .0004 THICK MAX.

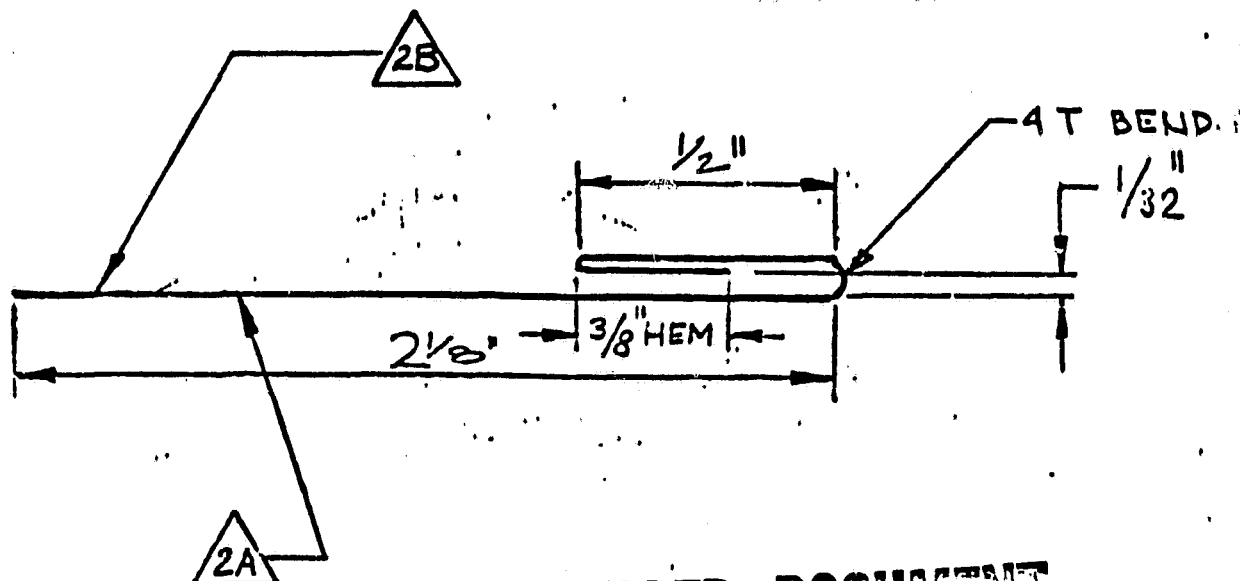
1. MATERIAL: 24 GAGE STEEL SHEET PER ASTM-A-446-76 GRADE "A" G-90 ZINC GALVANIZED

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOL RANGES ARE ± FRACTIONS: DECIMALS ANGLES 1/8 1/16 1/32 1/64 1/2 1 1 1/2 2 3 4 5 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118 120 122 124 126 128 130 132 134 136 138 140 142 144 146 148 150 152 154 156 158 160 162 164 166 168 170 172 174 176 178 180 182 184 186 188 190 192 194 196 198 200 202 204 206 208 210 212 214 216 218 220 222 224 226 228 230 232 234 236 238 240 242 244 246 248 250 252 254 256 258 260 262 264 266 268 270 272 274 276 278 280 282 284 286 288 290 292 294 296 298 300 302 304 306 308 310 312 314 316 318 320 322 324 326 328 330 332 334 336 338 340 342 344 346 348 350 352 354 356 358 360 362 364 366 368 370 372 374 376 378 380 382 384 386 388 390 392 394 396 398 400 402 404 406 408 410 412 414 416 418 420 422 424 426 428 430 432 434 436 438 440 442 444 446 448 450 452 454 456 458 460 462 464 466 468 470 472 474 476 478 480 482 484 486 488 490 492 494 496 498 500 502 504 506 508 510 512 514 516 518 520 522 524 526 528 530 532 534 536 538 540 542 544 546 548 550 552 554 556 558 560 562 564 566 568 570 572 574 576 578 580 582 584 586 588 590 592 594 596 598 600 602 604 606 608 610 612 614 616 618 620 622 624 626 628 630 632 634 636 638 640 642 644 646 648 650 652 654 656 658 660 662 664 666 668 670 672 674 676 678 680 682 684 686 688 690 692 694 696 698 700 702 704 706 708 710 712 714 716 718 720 722 724 726 728 730 732 734 736 738 740 742 744 746 748 750 752 754 756 758 760 762 764 766 768 770 772 774 776 778 780 782 784 786 788 790 792 794 796 798 800 802 804 806 808 810 812 814 816 818 820 822 824 826 828 830 832 834 836 838 840 842 844 846 848 850 852 854 856 858 860 862 864 866 868 870 872 874 876 878 880 882 884 886 888 890 892 894 896 898 900 902 904 906 908 910 912 914 916 918 920 922 924 926 928 930 932 934 936 938 940 942 944 946 948 950 952 954 956 958 960 962 964 966 968 970 972 974 976 978 980 982 984 986 988 990 992 994 996 998 1000 1002 1004 1006 1008 1010 1012 1014 1016 1018 1020 1022 1024 1026 1028 1030 1032 1034 1036 1038 1040 1042 1044 1046 1048 1050 1052 1054 1056 1058 1060 1062 1064 1066 1068 1070 1072 1074 1076 1078 1080 1082 1084 1086 1088 1090 1092 1094 1096 1098 1100 1102 1104 1106 1108 1110 1112 1114 1116 1118 1120 1122 1124 1126 1128 1130 1132 1134 1136 1138 1140 1142 1144 1146 1148 1150 1152 1154 1156 1158 1160 1162 1164 1166 1168 1170 1172 1174 1176 1178 1180 1182 1184 1186 1188 1190 1192 1194 1196 1198 1200 1202 1204 1206 1208 1210 1212 1214 1216 1218 1220 1222 1224 1226 1228 1230 1232 1234 1236 1238 1240 1242 1244 1246 1248 1250 1252 1254 1256 1258 1260 1262 1264 1266 1268 1270 1272 1274 1276 1278 1280 1282 1284 1286 1288 1290 1292 1294 1296 1298 1300 1302 1304 1306 1308 1310 1312 1314 1316 1318 1320 1322 1324 1326 1328 1330 1332 1334 1336 1338 1340 1342 1344 1346 1348 1350 1352 1354 1356 1358 1360 1362 1364 1366 1368 1370 1372 1374 1376 1378 1380 1382 1384 1386 1388 1390 1392 1394 1396 1398 1400 1402 1404 1406 1408 1410 1412 1414 1416 1418 1420 1422 1424 1426 1428 1430 1432 1434 1436 1438 1440 1442 1444 1446 1448 1450 1452 1454 1456 1458 1460 1462 1464 1466 1468 1470 1472 1474 1476 1478 1480 1482 1484 1486 1488 1490 1492 1494 1496 1498 1500 1502 1504 1506 1508 1510 1512 1514 1516 1518 1520 1522 1524 1526 1528 1530 1532 1534 1536 1538 1540 1542 1544 1546 1548 1550 1552 1554 1556 1558 1560 1562 1564 1566 1568 1570 1572 1574 1576 1578 1580 1582 1584 1586 1588 1590 1592 1594 1596 1598 1600 1602 1604 1606 1608 1610 1612 1614 1616 1618 1620 1622 1624 1626 1628 1630 1632 1634 1636 1638 1640 1642 1644 1646 1648 1650 1652 1654 1656 1658 1660 1662 1664 1666 1668 1670 1672 1674 1676 1678 1680 1682 1684 1686 1688 1690 1692 1694 1696 1698 1700 1702 1704 1706 1708 1710 1712 1714 1716 1718 1720 1722 1724 1726 1728 1730 1732 1734 1736 1738 1740 1742 1744 1746 1748 1750 1752 1754 1756 1758 1760 1762 1764 1766 1768 1770 1772 1774 1776 1778 1780 1782 1784 1786 1788 1790 1792 1794 1796 1798 1800 1802 1804 1806 1808 1810 1812 1814 1816 1818 1820 1822 1824 1826 1828 1830 1832 1834 1836 1838 1840 1842 1844 1846 1848 1850 1852 1854 1856 1858 1860 1862 1864 1866 1868 1870 1872 1874 1876 1878 1880 1882 1884 1886 1888 1890 1892 1894 1896 1898 1900 1902 1904 1906 1908 1910 1912 1914 1916 1918 1920 1922 1924 1926 1928 1930 1932 1934 1936 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048 2050 2052 2054 2056 2058 2060 2062 2064 2066 2068 2070 2072 2074 2076 2078 2080 2082 2084 2086 2088 2090 2092 2094 2096 2098 2100 2102 2104 2106 2108 2110 2112 2114 2116 2118 2120 2122 2124 2126 2128 2130 2132 2134 2136 2138 2140 2142 2144 2146 2148 2150 2152 2154 2156 2158 2160 2162 2164 2166 2168 2170 2172 2174 2176 2178 2180 2182 2184 2186 2188 2190 2192 2194 2196 2198 2200 2202 2204 2206 2208 2210 2212 2214 2216 2218 2220 2222 2224 2226 2228 2230 2232 2234 2236 2238 2240 2242 2244 2246 2248 2250 2252 2254 2256 2258 2260 2262 2264 2266 2268 2270 2272 2274 2276 2278 2280 2282 2284 2286 2288 2290 2292 2294 2296 2298 2300 2302 2304 2306 2308 2310 2312 2314 2316 2318 2320 2322 2324 2326 2328 2330 2332 2334 2336 2338 2340 2342 2344 2346 2348 2350 2352 2354 2356 2358 2360 2362 2364 2366 2368 2370 2372 2374 2376 2378 2380 2382 2384 2386 2388 2390 2392 2394 2396 2398 2400 2402 2404 2406 2408 2410 2412 2414 2416 2418 2420 2422 2424 2426 2428 2430 2432 2434 2436 2438 2440 2442 2444 2446 2448 2450 2452 2454 2456 2458 2460 2462 2464 2466 2468 2470 2472 2474 2476 2478 2480 2482 2484 2486 2488 2490 2492 2494 2496 2498 2500 2502 2504 2506 2508 2510 2512 2514 2516 2518 2520 2522 2524 2526 2528 2530 2532 2534 2536 2538 2540 2542 2544 2546 2548 2550 2552 2554 2556 2558 2560 2562 2564 2566 2568 2570 2572 2574 2576 2578 2580 2582 2584 2586 2588 2590 2592 2594 2596 2598 2600 2602 2604 2606 2608 2610 2612 2614 2616 2618 2620 2622 2624 2626 2628 2630 2632 2634 2636 2638 2640 2642 2644 2646 2648 2650 2652 2654 2656 2658 2660 2662 2664 2666 2668 2670 2672 2674 2676 2678 2680 2682 2684 2686 2688 2690 2692 2694 2696 2698 2700 2702 2704 2706 2708 2710 2712 2714 2716 2718 2720 2722 2724 2726 2728 2730 2732 2734 2736 2738 2740 2742 2744 2746 2748 2750 2752 2754 2756 2758 2760 2762 2764 2766 2768 2770 2772 2774 2776 2778 2780 2782 2784 2786 2788 2790 2792 2794 2796 2798 2800 2802 2804 2806 2808 2810 2812 2814 2816 2818 2820 2822 2824 2826 2828 2830 2832 2834 2836 2838 2840 2842 2844 2846 2848 2850 2852 2854 2856 2858 2860 2862 2864 2866 2868 2870 2872 2874 2876 2878 2880 2882 2884 2886 2888 2890 2892 2894 2896 2898 2900 2902 2904 2906 2908 2910 2912 2914 2916 2918 2920 2922 2924 2926 2928 2930 2932 2934 2936 2938 2940 2942 2944 2946 2948 2950 2952 2954 2956 2958 2960 2962 2964 2966 2968 2970 2972 2974 2976 2978 2980 2982 2984 2986 2988 2990 2992 2994 2996 2998 3000 3002 3004 3006 3008 3010 3012 3014 3016 3018 3020 3022 3024 3026 3028 3030 3032 3034 3036 3038 3040 3042 3044 3046 3048 3050 3052 3054 3056 3058 3060 3062 3064 3066 3068 3070 3072 3074 3076 3078 3080 3082 3084 3086 3088 3090 3092 3094 3096 3098 3100 3102 3104 3106 3108 3110 3112 3114 3116 3118 3120 3122 3124 3126 3128 3130 3132 3134 3136 3138 3140 3142 3144 3146 3148 3150 3152 3154 3156 3158 3160 3162 3164 3166 3168 3170 3172 3174 3176 3178 3180 3182 3184 3186 3188 3190 3192 3194 3196 3198 3200 3202 3204 3206 3208 3210 3212 3214 3216 3218 3220 3222 3224 3226 3228 3230 3232 3234 3236 3238 3240 3242 3244 3246 3248 3250 3252 3254 3256 3258 3260 3262 3264 3266 3268 3270 3272 3274 3276 3278 3280 3282 3284 3286 3288 3290 3292 3294 3296 3298 3300 3302 3304 3306 3308 3310 3312 3314 3316 3318 3320 3322 3324 3326 3328 3330 3332 3334 3336 3338 3340 3342 3344 3346 3348 3350 3352 3354 3356 3358 3360 3362 3364 3366 3368 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3770 3772 3774 3776 3778 3780 3782 3784 3786 3788 3790 3792 3794 3796 3798 3800 3802 3804 3806 3808 3810 3812 3814 3816 3818 3820 3822 3824 3826 3828 3830 3832 3834 3836 3838 3840 3842 3844 3846 3848 3850 3852 3854 3856 3858 3860 3862 3864 3866 3868 3870 3872 3874 3876 3878 3880 3882 3884 3886 3888 3890 3892 3894 3896 3898 3900 3902 3904 3906 3908 3910 3912 3914 3916 3918 3920 3922 3924 3926 3928 3930 3932 3934 3936 3938 3940 3942 3944 3946 3948 3950 3952 3954 3956 3958 3960 3962 3964 3966 3968 3970 3972 3974 3976 3978 3980 3982 3984 3986 3988 3990 3992 3994 3996 3998 4000 4002 4004 4006 4008 4010 4012 4014 4016 4018 4020 4022 4024 4026 4028 4030 4032 4034 4036 4038 4040 4042 4044 4046 4048 4050 4052 4054 4056 4058 4060 4062 4064 4066 4068 4070 4072 4074 4076 4078 4080 4082 4084 4086 4088 4090 4092 4094 4096 4098 4100 4102 4104 4106 4108 4110 4112 4114 4116 4118 4120 4122 4124 4126 4128 4130 4132 4134 4136 4138 4140 4142 4144 4146 4148 4150 4152 4154 4156 4158 4160 4162 4164 4166 4168 4170 4172 4174 4176 4178 4180 4182 4184 4186 4188 4190 4192 4194 4196 4198 4200 4202 4204 4206 4208 4210 4212 4214 4216 4218 4220 4222 4224 4226 4228 4230 4232 4234 4236 4238 4240 4242 4244 4246 4248 4250 4252 4254 4256 4258 4260 4262 4264 4266 4268 4270 4272 4274 4276 4278 4280 4282 4284 4286 4288 4290 4292 4294 4296 4298 4300 4302 4304 4306 4308 4310 4312 4314 4316 4318 4320 4322 4324 4326 4328 4330 4332 4334 4336 4338 4340 4342 4344 4346 4348 4350 4352 4354 4356 4358 4360 4362 4364 4366 4368 4370 4372 4374 4376 4378 4380 4382 4384 4386 4388 4390 4392 4394 4396 4398 4400 4402 4404 4406 4408 4410 4412 4414 4416 4418 4420 4422 4424 4426 4428 4430 4432 4434 4436 4438 4440 4442 4444 4446 4448 4450 4452 4454 4456 4458 4460 4462 4464 4466 4468 4470 4472 4474 4476 4478 4480 4482 4484 4486 4488 4490 4492 4494 4496 4498 4500 4502 4504 4506 4508 4510 4512 4514 4516 4518 4520 4522 4524 4526 4528 4530 4532 4534 4536 4538 4540 4542 4544 4546 4548 4550 4552 4554 4556 4558 4560 4562 4564 4566 4568 4570 4572 4574 4576 4578 4580 4582 4584 4586 4588 4590 4592 4594 4596 4598 4600 4602 4604 4606 4608 4610 4612 4614 4616 4618 4620 4622 4624 4626 4628 4630 4632 4634 4636 4638 4640 4642 4644 4646 4648 4650 4652 4654 4656 4658 4660 4662 4664 4666 4668 4670 4672 4674 4676 4678 4680 4682 4684 4686 4688 4690 4692 4694 4696 4698 4700 4702 4704 4706 4708 4710 4712 4714 4716 4718 4720 4722 4724 4726 4728 4730 4732 4734 4736 4738 4740 4742 4744 4746 4748 4750 4752 4754 4756 4758 4760 4762 4764 4766 4768 4770 4772 4774 4776 4778 4780 4782 4784 4786 4788 4790 4792 4794 4796 47
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APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
012441	J.P.L.		REL FOR PROD PER EO 192	1-8-81	<i>[Signature]</i>
		A	REVISED PER EO 213	1-31-81	<i>[Signature]</i>

ORIGINAL PAGE IS  
OF POOR QUALITY



**UNCONTROLLED DOCUMENT**

For latest revision, check with  
document control

3. LENGTH: 12' 0"

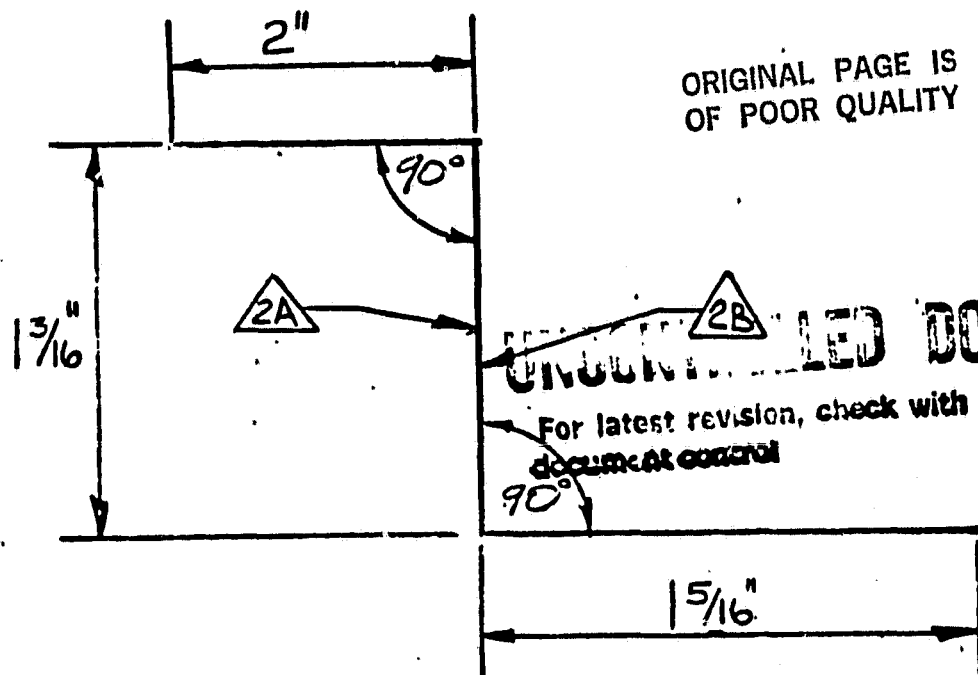
2. FINISH: A. .0015 THICK TEDLAR FILM, COLOR CHARCOAL No. 150BL3000 ON SIDE SHOWN.  
B. OPPOSITE SIDE TO HAVE A CLEAR EPOXY WASH .0004 THICK MAX.

1. MATERIAL: 24 GAGE STEEL SHEET PER ASTM-A-446 GRADE A, G-90 ZINC GALVANIZED.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: ± FRACTIONS DECIMALS ANGLES 1/16 .005 1/2° .010 .010 REMOVE ALL BURRS DIMENSION PER USAS 14.3 FINISH: <i>[Symbol]</i> DO NOT SCALE DRAWING	CONTRACT NO.		<b>ARCO Solar, Inc.</b> <small>Subsidiary of Atlantic Richfield Company</small> 20554 Plummer Street Chatsworth California 91311 (713) 998-0651		
	APPROVALS	DATE			
	DRAFTSMAN	R.S.	5-8-80	<b>STARTER</b>	
	CHECKER				
DESIGNER					
	ENGINEER	1-8-81	SIZE	FSCM NO.	DRAWING NO.
	<i>[Signature]</i>	1-8-81	A	270	012444 A
			SCALE	WEIGHT	SHEET
			NONE		1 OF 1

APPLICATION			REVISIONS		
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
012441	JPL		REL. FOR PROD. PER EO 192	1-8-81	<i>SWT</i>
		A	REVISED PER EO 213	1-30-81	<i>E.B.</i>



3. LENGTH: 12' 0"

- △ FINISH: A. .0015 THICK TEDLAR FILM, COLOR CHARCOAL #150BL30CC ON SIDE SHOWN.  
B. OPPOSITE SIDE TO HAVE A CLEAR EPOXY WASH .0004, THICK MAX.

1. MATERIAL: 24 GAGE STEEL SHEET PER ASTM-A-44G-76 GRADE "A" G-90 ZINC GALVANIZED.

NOTES:

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES 1/2 .015 .1 .01 .005 .05 .005 .002 .01	CONTRACT NO.		<b>ARCO Solar, Inc.</b> <small>Subsidiary of Atlantic Richfield Company</small> 20554 Plummer Street Chatsworth California 91311 (214) 998-0667	
	APPROVALS	DATE		
	DRAFTSMAN <i>M.T.S.</i> CHECKER DESIGNER ENGINEER <i>Cashner</i>	1/8/81  1-8-81	'Z' CLOSURE	
	FINISH DO NOT SCALE DRAWING	APPROVED <i>[Signature]</i> 1-8-81		
SIZE <b>A</b> FSCM NO. <b>270</b> DRAWING NO. <b>012443</b> REV <b>A</b>		SCALE _____ WEIGHT _____ SHEET <b>1</b> OF <b>1</b>		